



High Energy Physics in Africa

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I also do physics engagement within the United States (MSI and URM in particular). In this talk, I will concentrate on Africa

July 25, 2022

Snowmass Community Summer Study



@BrookhavenLab

Moroccan HEP Cluster

- ★ Joined ATLAS in 1996
- ★ Hosted ATLAS week in 2013
- ★ Cluster of 7 institutes
- ★ EM Calorimeter
- ★ Software, Computing
- ★ Phase 1, 2 upgrades
- ★ SM, BSM, Higgs, Dark Sectors
- ★ ~40 people
- ★ ANTARES/KM3NeT

Algeria: associate member of LHCb (UFRJ, Brazil)

Egypt

- ★ Egyptian Network of HEP joined CMS in 2010
- ★ 2019, CHEP-FU member of CMS
- ★ RPC tests, assembly, Trigger; GEM
- ★ SM, Higgs, BSM, Dark Sectors
- ★ Super computer lab ~31 people

HEP in Africa

African countries with formal HEP programs and other countries with physicists in HEP

- Morocco: ATLAS, Theory
- Egypt: CMS, Theory
- South Africa: ATLAS, ALICE, ISOLDE, Theory
- Madagascar: DUNE, Theory
- Other countries with physicists in HEP

South Africa – CERN Program

- ★ ISOLDE
- ★ Theory, computing

Madagascar

- ★ Member of DUNE
- ★ Near detector CDR
- ★ 7 people
- ★ HEP phenomenology
- ★ HEPMAD conference series since 2001

South Africa – CERN Program

- ★ ALICE since 2001, 3 institutes: dHLT, di-μ studies, upgrade
- ★ ATLAS, affiliation to BNL 2008-2010, full member since 2010. ²
- ★ Significant group, rich physics

Building capacity—the African School of Physics (ASP)

3-6 months US research visits

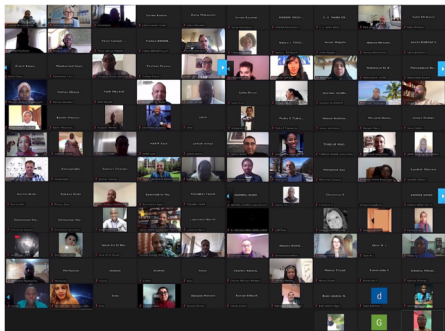


High School teachers



Student Mentorship

The Second Biennial African Conference on Fundamental Physics and Applications
March 7-11, 2022



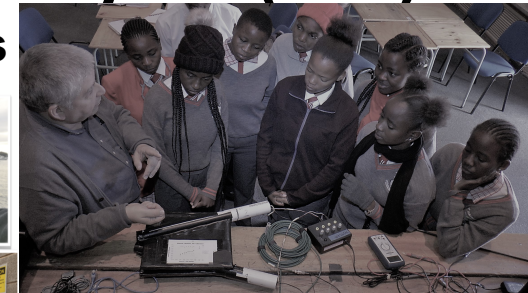
Summer 2019 BNL

African School of Physics

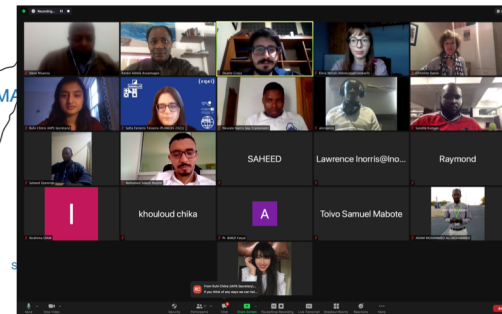
- South Africa, 2010, 2022
- Ghana 2012
- Senegal 2014
- Rwanda 2016
- Namibia 2018
- Morocco 2020-online, 2024

Over 2k student applicants;
Selection rate: 1 in 5

- ★ ASP is much more than a school;
- ★ it's a system of physics activities for education & research development



High School Outreach

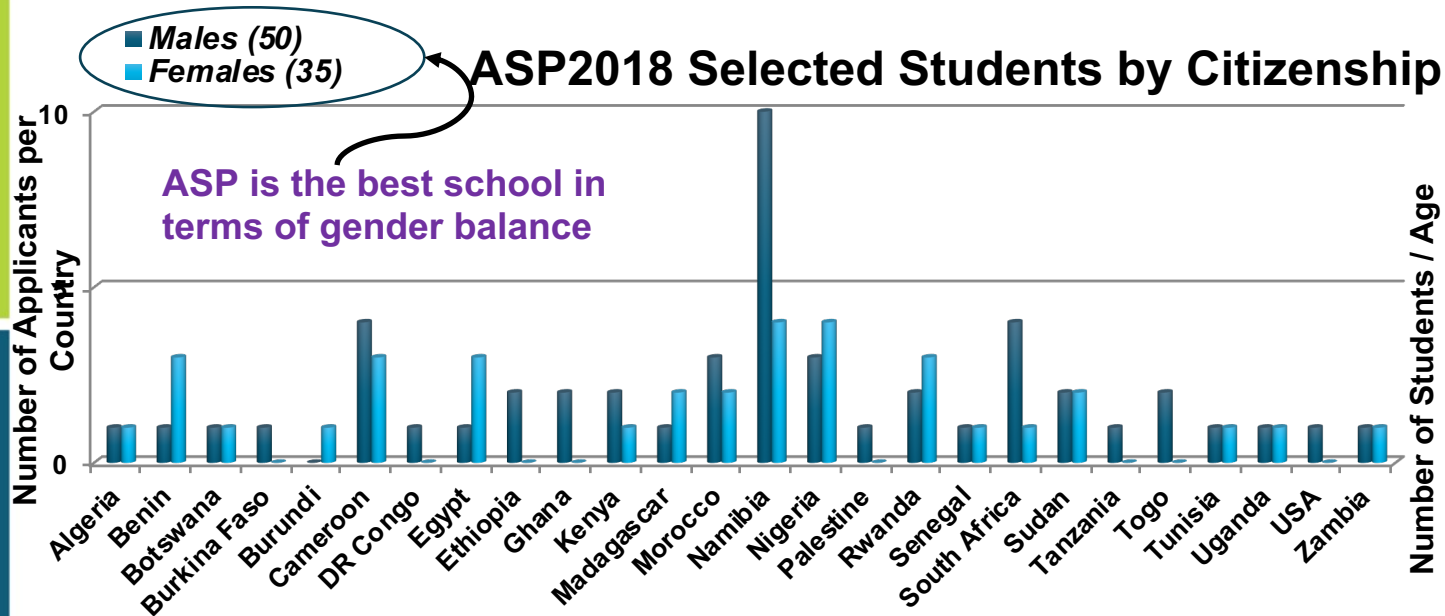


Online lectures

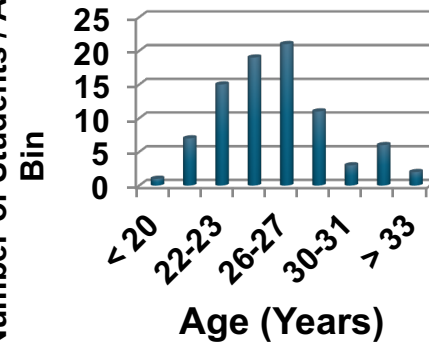


Engagement with Policy makers

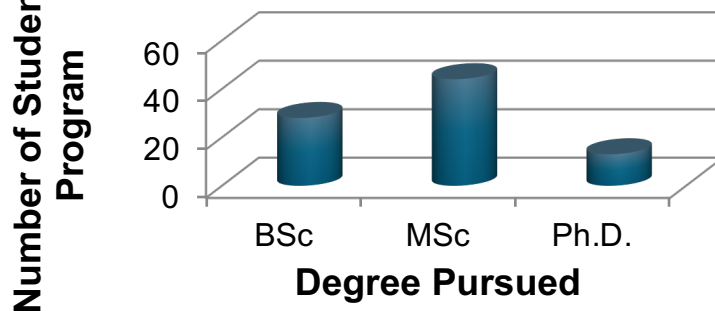
Created with mapchart.net



ASP2018 Selected Students by Age

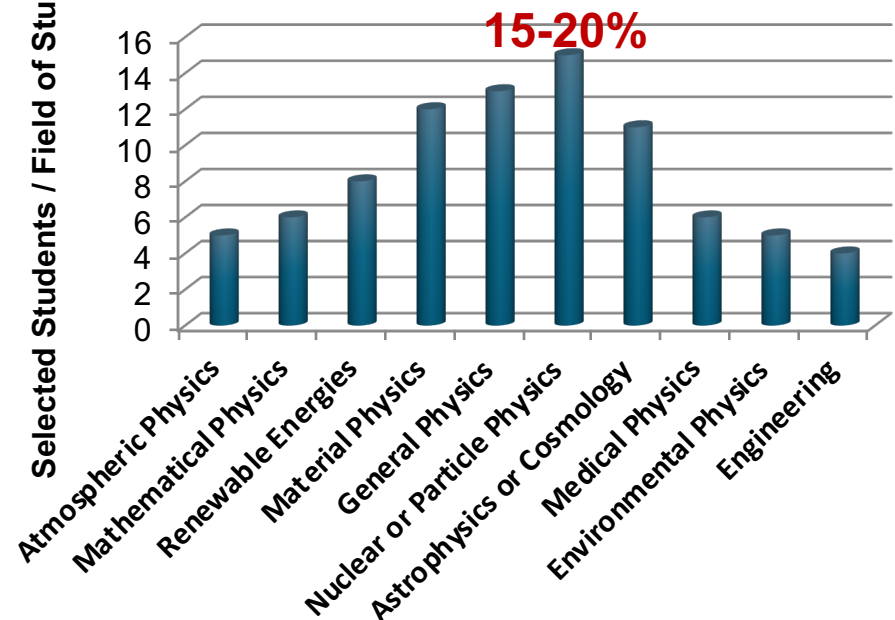


ASP2018 Selected Student Degree Programs



523 applications in 2018
85 selected; 30 waiting list

ASP2018 Selected Students by Field of Study

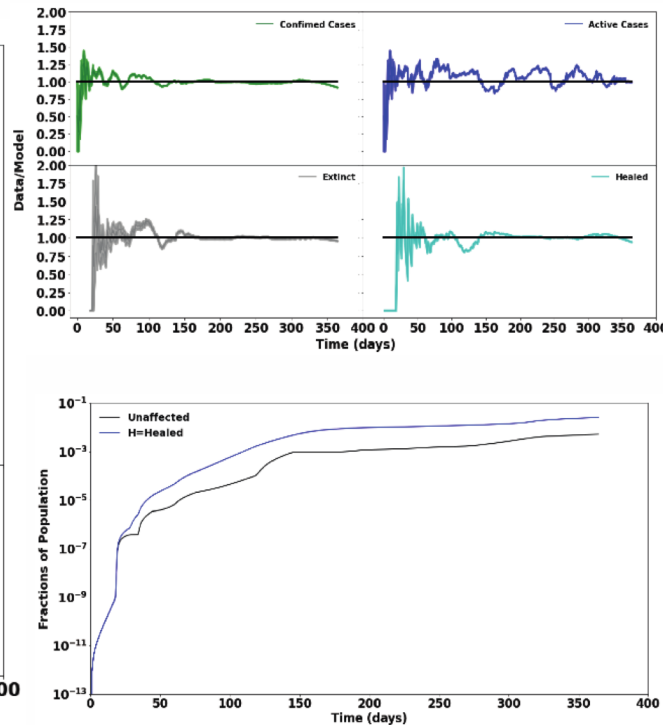
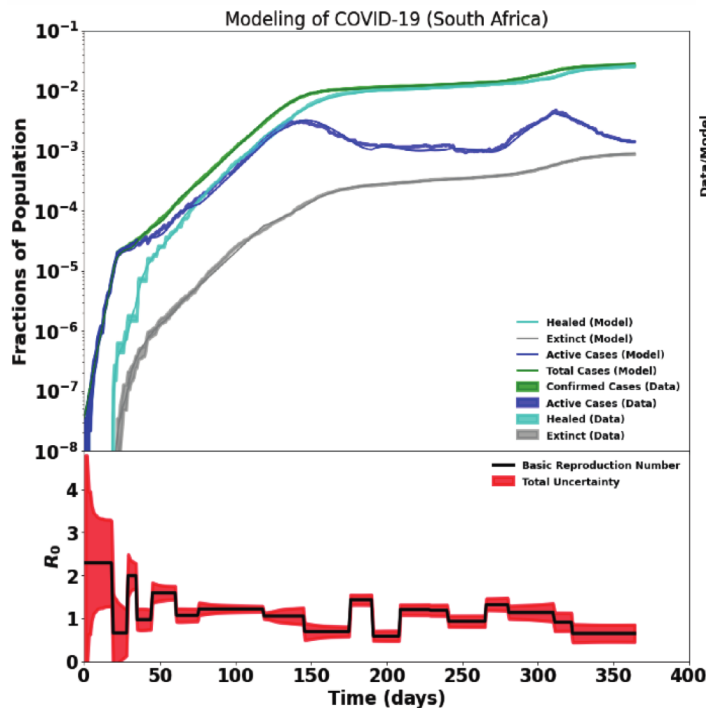


During the COVID-19 pandemic

- ★ 20 ASP student alumni obtained PhD in physics; about 1/3 in HEP
 - ★ There were many others before the pandemic
- ★ ASP2020 postponed; organized online in 2021
- ★ African students modeled 1 year of COVID-19 data of their own countries. 10 countries considered; over 50% of entire COVID-19 cases in Africa in this study; results published in the Scientific African DOI
<https://doi.org/10.1016/j.sciaf.2021.e00987>

APS alumni learned about

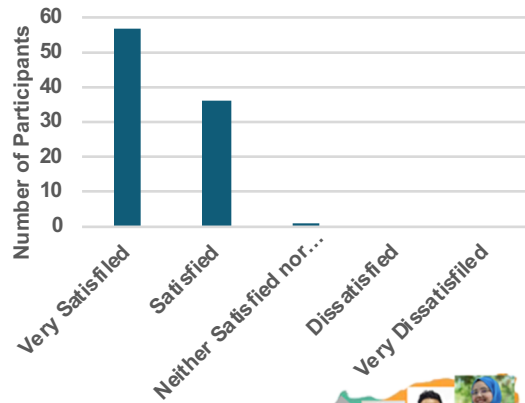
- ❖ Analysis tools in C++ and Python
- ❖ Understanding their data
- ❖ Modeling, goodness of fit
- ❖ Statistical analysis
- ❖ Uncertainties (statistical, systematic)
- ❖ Estimation of basic reproduction number R_0
- ❖ Giving scientific talks
- ❖ Writing a paper and responding referees comments



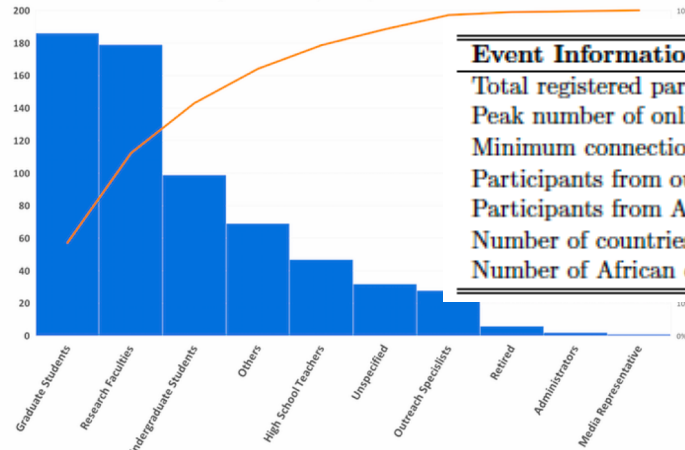
Challenging online efforts: **worked with students with full fluency only in French, English or Portuguese**

During the COVID-19 pandemic

General level of satisfaction with ASP2021



Registered Participants by Professional Status



Event Information	Number of Engagements
Total registered participants	649
Peak number of online connections	191
Minimum connections in plenary sessions	120
Participants from outside Africa	86
Participants from Africa	563
Number of countries represented	54
Number of African countries represented	33

2nd African conference on Fundamental and Applied Physics, March 7-11, 2022

THE SIXTH BIENNIAL



African School of Fundamental Physics and Applications

July 19-30, 2021

Virtual Edition



www.africanschoolofphysics.org



3rd conference in 2023

ASP Alumni impacts...



Dr. Laza Rakotondravohitra
Alumnus of ASP2010
PhD at Fermilab on MINERvA,
thanks to Prof. Young-Kee Kim.
Laza was instrumental in getting
his country, Madagascar, into
DUNE. Thanks to David Martinez



Dr. Marie Chantal Cyulinyana
Alumna of ASP2016
PhD, Renewable energies
Uni. of Johannesburg
Rwandan Ministry of Education
Rwandan Association of Women
in Science & Engineering
(RAWISE)



Dr. Benard Mulilo
Alumnus of ASP2010
PhD at RIKEN Japan on PHENIX.
Now, working to develop a heavy
ion physics program in his
country, Zambia

Africans in Snowmass and CSS

- We have African participants in Snowmass and CSS
- Small but worth noting
- Cameroon, Nigeria, Senegal, South Africa, Togo, Tunisia, Zambia, ..., are represented



Dr. Diallo Boye

Alumnus of ASP2012

Post-doc at BNL on ATLAS.

He gave a CSS talk on “Testing DM with the Higgs boson” based on this white paper

<https://doi.org/10.31526/lhep.2022.270>



Proposal to add vector DM interpretation and extension below 1 GeV

Prof. Azwinndini Muronga

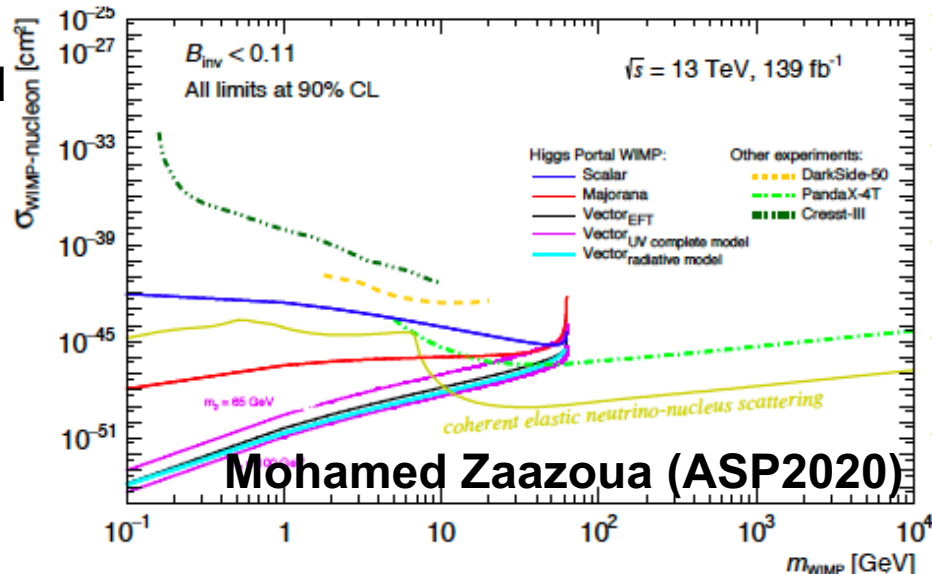
Heavy Ion Physics Theorist

Dean of Science

Nelson Mandela University, South Africa

Snowmass Advisory Committee.

Co-convener of CEF05. Co-author of many white papers and TG report



Contributed paper jointly by Mohammed V University Morocco, Uni. of Johannesburg South Africa and BNL, in EF10

Coming soon — the 7th edition of the African School of Physics, ASP2022

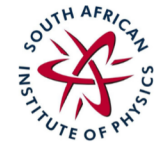
Hosted by the Prof.
Azwinndini Muronga



NELSON MANDELA
UNIVERSITY

The 7th Biennial African School of
Fundamental Physics and Applications

28 November - 9 December 2022



Scientific Program

Topics

- Space Physics, Astrophysics & Cosmology
- Nuclear and Particle Physics
- Medical and Radiation Physics
- Biophysics
- Physics Education, Outreach, & Communication
- Diversity Equity & Inclusion in Physics
- Condensed and Material Physics
- Photonics
- Applied and Industrial Physics
- Theoretical and Computational Physics
- Physics for Sustainable Development
- 100 Years of Physics in Africa and the Future

Activities

- Workshops for High School Teachers
- Outreach for Secondary Schools
- Physics Lectures and Tutorials for Students
- Forums to Discuss Capacity Development & Retention

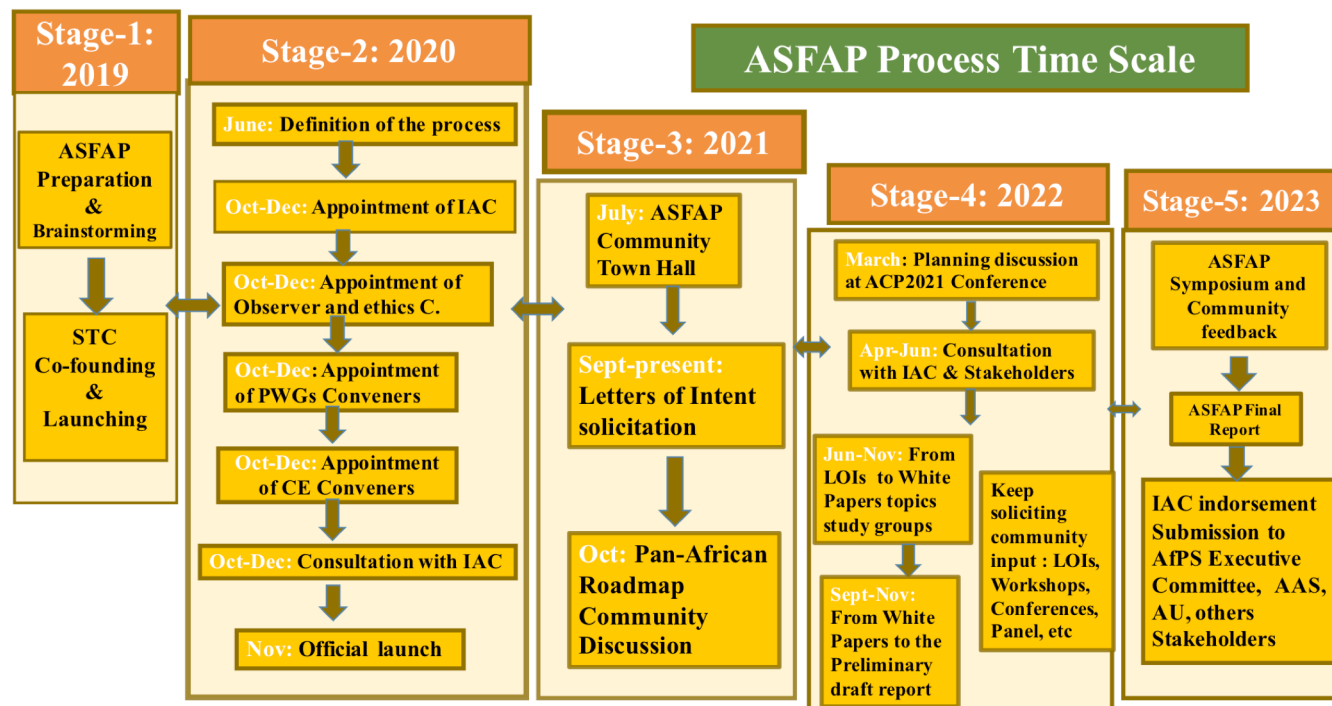
100 years of Physics in Africa
Past, Present, And Future

Gqeberha (Formerly Port Elizabeth)



In progress — the African Strategy for Fundamental and Applied Physics (ASFAP)

- Mandated by the African Physics Society (AfPS)
- Includes other fields in addition to HEP
- Follow the steps of our colleagues in Latin America
- Learn the process of community-driven physics roadmap exercise
- Strengthen AfPS
- Complement top-down strategies
- Slow but steady progress; interim report to be submitted to the IAC in the next few months



PHYSICS GROUPS

Accelerators
 Astrophysics &
 Cosmology
 Atomic & Molecular
 Physics
 Biophysics
 Computing & 4IR
 Earth Science
 Energy
 Fluid and Plasma
 Instrumentation &
 Detectors
 Light Sources
 Condensed Matter &
 Materials Physics
 Medical Physics
 Nuclear Physics
 Particle Physics
 Optics and Photonics
 Complex Systems

ENGAGEMENT

Community Engagement
 Observers Committee
 Ethics Committee
 Physics Education
 Women in Physics Forum
 Young Physicists Forum

Why should the US care about HEP in Africa and Latin America?

- It is a legitimate question
- We submitted a Snowmass white paper to answer that question; please check it out, [arXiv:2203.10060](https://arxiv.org/abs/2203.10060)

We are interested in ASP-USPAS collaboration to train African students in accelerator physics. Also, we would like to extend the ASP short-term visits for research program to other Labs.

Acknowledgements

Special thanks to Prof. Young-Kee Kim, Prof. Peter Jenni, Prof. Fernando Quevedo, Dr. Herman White.

We appreciate the continued support of ICTP, DOE, BNL, South African National Research Foundation, South African Institute of Physics

We need your support and partnerships; but, it is important for us, Africans, to manage and lead these activities ourselves.